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Procedia Social and Behavioral Sciences 6 (2010) 198–199

Procedia
Social and Behavioral Sciences

Academy of Aphasia 2010

How Lexical Processing Deficits Affect Sentence Comprehension in Agrammatic Broca's Aphasia

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Introduction

Individuals with agrammatic Broca's aphasia show lexical processing deficits, such as deficits in lexical access or lexical integration (Hagoort, 1997; Milberg, Blumstein, & Dworetzky, 1987). However, few studies have looked at the effects of these deficits on agrammatic sentence comprehension. We conducted a series of eyetracking experiments to test lexical access and lexical integration in agrammatic aphasia. We examined the latency of fixations to pictures after nonlinguistic and lexical stimuli to examine whether lexical access is delayed. We then manipulated rate of speech of complex sentences to assess whether delayed lexical access affects sentence comprehension. We also investigated whether lexical integration is impaired and whether impaired lexical integration affects sentence comprehension by manipulating cloze probability of complex sentences.

Methods

Participants. Ten individuals with agrammatic Broca's aphasia (ages: 37-74; WAB AQs: 56.4-86.2), and ten unimpaired age-matched participants (ages: 35-75) were tested. All participants were native speakers of English, and demonstrated good visual and hearing acuity. There was no reported history of neurological and psychological disorders.

Procedures. Eye movements were recorded while participants looked at a computer screen with four objects during presentation of sounds, words or stories. Stories contained 3 sentences – an introductory sentence, a critical complex sentence and a comprehension probe. Latency of eye movements, proportion of fixations and accuracy on probes were analyzed.

Results

Lexical access. Eye movement latency was slower for aphasic individuals compared to controls for lexical stimuli ($Z=-2.676$, $p=.007$) but not for non-linguistic stimuli (Mann-Whitney $Z=.493$, $p=.622$). Aphasic individuals showed lower accuracy on sentence comprehension compared to controls for both speech rates (Slow: $Z=-3.352$, $p=.001$; Normal: $Z=-3.684$, $p=.001$). However, no difference in accuracy was found between the two speech rates for either group (Control: $Z=-1.542$, $p=.123$; Aphasic: $Z=.-.356$, $p=.722$).

Lexical integration. Analysis of eye-movements showed that both participant groups showed similar eye movements for the high cloze condition but not the low cloze condition, with the aphasic group showing showing fewer fixations to the antecedent at the gap site in the low cloze condition. Aphasic individuals showed lower accuracy on sentence comprehension for both conditions compared to controls (High Cloze: $Z=-3.526$, $p=.001$; Low Cloze: $Z=-3.514$, $p=.001$). The control group showed no difference in accuracy between the two cloze

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1877-0428 © 2010 Published by Elsevier Ltd.
doi:10.1016/j.sbspro.2010.08.099

conditions (Z=-1.192, p=.233), whereas the aphasic group showed higher accuracy on high cloze compared to low cloze (Z=-2.666, p=.008).

Conclusion

These results suggest that lexical access and lexical integration are impaired in Broca's aphasia as indicated by delayed eye movements to lexical items and decreased eye movements to low cloze antecedents. However, aphasic comprehension was affected only by the difference in cloze and not the difference in rates of speech. These results suggest that while lexical access and lexical integration are both impaired in Broca's aphasia, it is the deficit in lexical integration which affects sentence comprehension.

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